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ABSTRACT

A study was conducted to determine whether chess instruction would change the measure of a student's field-dependence or field-independence as determined by the Group Embedded Figures Test (GEFT) in the direction of stronger field independence. Field dependence/independence is a psychological construct referring to a global versus an analytical way of perceiving that entails the ability to perceive items without being influenced by the background. This was done by comparing the results of pretest and posttest scores on the GEFT for 11 African-American high school students (four males, seven females) in a rural northern Louisiana school. These students had received approximately 50 hours of direct chess instruction and playing experience. Chess instruction did have a significant effect on GEFT scores for females, but not male, students. Whether this might transfer to improved mathematics achievement is beyond the scope of this study, but it is a problem worth investigating. It is logical to surmise that whatever skill chess instruction enhanced for females may have already been present for males. (Contains 6 figures and 15 references.) (SLD)

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"The Effects of Chess Instruction on Students' Level of Field Dependence/ Independence"

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Purpose

The purpose of this study was to determine if chess instruction would change the measure of a student's field-dependence/independence as determined by the Group Embedded Figures Test, in the direction of stronger field independence. This was done by comparing the results of pre and post-test scores on the GEFT for a class of high school Humanities students who had received approximately 50 hours of chess instruction and playing experience.

Design

The project began on January 29, 1997 when 11 Humanities students were administered the Group Embedded Figures Test. Directions for administrating the test were followed exactly as prescribed in the Group Embedded Figures Test Manual by Witkin, Oltman, Raskin, and Karp (1971). The students then received approximately 50 hours of chess instruction over the following two months and then were tested again. The minimum recommended time between test administrations is 60 days.

Subjects

The subjects in this study were 11 high school students enrolled in a Humanities class in a high school located in rural northern Louisiana. All 11 students are African-American, aged 16 and 17 years. Four are male and seven are female.

Discussion

As doors of opportunity are opening for minority and female students which were not previously available, many of these students are encountering extreme difficulty in succeeding in science or mathematics intensive fields, despite having strong over-all academic records. It is possible that this lack of success can be linked to a phenomenon known as Field Dependence/Independence.

Field Dependence/Independence is a psychological construct related to a "global versus an analytical way of perceiving, and entails the ability to perceive items without being influenced by the background" (Chinien & Boutin, 1993). This was first researched during World War II when Herman Witkin discovered that some fighter pilots could maintain their orientation while traveling long distances through clouds or fog while others could not. The Group Embedded Figures Test was developed to determine an individual's FD/I with a high degree of reliability: $r = 0.82$ for males and $r = 0.63$ for females (Chinien and Boutin, 1993).

Research indicates that relatively Field Dependent individuals are drawn to people, tend to be alert to social cues, and generally have highly developed interpersonal skills. They like to work in groups and demonstrate a preference for academic subjects and occupations that are people centered. Field Dependent individuals have a global perception and need more time to solve problems. They use "external referents for self definition" (Chinien and Boutin, 1993).

Field Independent individuals are more impersonal, less alert to social cues, and have less developed interpersonal skills. They tend to be "aloof, theoretical and not sensitive to

other around them. They are not sensitive to social criticisms and are not easily influenced by others. They are abstract-analytical in orientation and therefore tend to learn abstract content better. They are known for solving problems rapidly (Chinien and Boutin, 1993).

Research indicates that certain professions by their nature are more accessible to individuals with one or the other of these predispositions (Eubank and Sparks, 1993). For example, mathematics, medicine, engineering, and the physical sciences attract individuals with Field Independent characteristics because the nature of the skills needed in these academic areas correspond to their strength. Field Dependent individuals' strengths lead them to career choices such as education, law, counseling, or other occupations that rely on communication skills.

Research also indicates that Field Dependence is highest among minorities and females. In some studies this has been shown to be as high as 40% (Ley, 1996). Lower socioeconomic status is also believed to be a contributing factor, but the degree to which it influences Field Dependence has not been determined. There is also a great deal of concern about the use of computer aided instruction with Field Dependent individuals because such factors as the color and pattern of the background have been shown to have very strong effects on the learners by Chinien and Boutin (1993), Descy (1990), and Dwyer and Moore (1992).

Chess instruction may prove to a valuable vehicle in enabling students to tap into more Field Independent behaviors when these behaviors are needed to perform particular academic tasks. Some research indicates that chess instruction has improved math

performance among middle school students (Christiaen and Verholfstadt, 1981) and that it has also improved over-all I.Q. scores (Van Zyl, 1991).

Because research concludes that chess expertise in children in heavily dependent upon spatial ability (Horgan and Morgan, 1990; Harston and Wason, 1983) and chess expertise among adults is dependent upon logical thinking ability (DeGroot, 1978), high school students may be the ideal age to select for this type of study because these subjects are in all likelihood making a transition from reliance on spatial ability to solve problems to reliance on logical thinking ability.

Methodology

The students received direct chess instruction from a certified teacher. This teacher is certified to teach Physics, Chemistry, Biology, General Science, Physical Science, and Mathematics by the state of Louisiana. The instructor has also been an active chess player for over twenty years and holds a United States Chess Federation rating of 1635.

Textbooks for the class included: Chess Rules for Students, Bain (1994); Chess Tactics for Students, Bain (1993); Bobby Fischer Teaches Chess, Fischer, Marguilles, and Mosenfelder, (1966); Chess in the Classroom, Katz (1992); and Comprehensive Chess Course Volumes I and II, Pelts and Alburt (1992). Instruction consisted of workbook assignments, limited lecture, and practical application of what the students learned by competing against each other in classroom tournaments.

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Results

The null hypothesis of this study was that there is no significant difference between the mean score of the Group Embedded Figures Test administered before chess instruction compared to the mean score after receiving chess instruction. The mean score for the whole group on the pre-test was 6.82 and the post-test mean was 9.09. The calculated t-value was 2.8. The t-table value for significance at the 0.05 level was 2.238. Therefore, the null hypothesis was rejected. Chess instruction did have a significant influence on the GEFT scores.

The calculated t-value for the group of seven female students was 2.6. The t-table value for significance at the 0.05 level was 2.447. Again the null hypothesis was rejected, demonstrating that chess instruction had a significant impact on the GEFT scores for the sub-

group of female students. There was however, no significant difference in the mean scores of the four male students participating in the study.

Conclusions

The study of chess does have a significant effect on student scores on the Group Embedded Figures Test. Whether or not this translates to greater mathematics achievement as reported by Christiaen, or Van Zyl, is beyond the scope of this study. However, because it is documented that students scoring higher on the GEFT generally score higher on mathematics achievement tests, the investigation is worth pursuing as a future area of study.

The fact that chess instruction had a significant effect on female students, but not male students is also extremely interesting. It seems logical to surmise that whatever skill is enhanced by chess instruction among females, may have already been present among the male participants.

History of Field Dependence/Independence (FD/I) Construct

- The work of Witkin et al. is credited with the greatest contributions to the FD/I construct.
- The construct was first discovered during observations of fighter pilots during World War II.
- Some pilots were found to have a greater perceptual orientation than other pilots. This prompted a series of experiments by Witkin and his team of reasearchers centering on the visual field and the perceived gravitational factors of the participants.
- These perceptual experiments showed a distinct difference in the manner that the subjects perceived the world around them.
- The concept that subjects used either an externeal visual field or an internal body perception to determine upright led to the designations "field dependent" to describe a subject that used an internal frame of reference, and the terms were intended only to describe the preferred frame of reference in orientation.
- The realization that subjects in these studies were being required mentally to remove (disembed) an item from an organized complex field led researchers to search for other cognitive tasks that required similar operations.

Field Dependence/Independence as a Cognitive Style

- One of the areas most heavily researched in this regard is that of the relationship between analytical problem solving and the FD/I Construct.
- By taking the elements of a problem out of the context of the existing situation, FI subjects were better able to analyze problems. FD were less capable of performing this task (Witkin & Goodenough, 1981).
- Witkin, Moore, Goodenough, and Cox (1977) also found that FI subjects were better able to resturcture unorganized information, while FD subjects struggled to process and restructure unorganized information.
- This discovery broadened the concept from a perceptual ability to include cognitive ability.
- Because cognitive style represents a learner's preferred mode of perceiving and processing information, understanding how it functions in the individual is of paramount importance.
- Visual perception and problem solving/ critical thinking are factors relating to both the FD/I Construct and chess playing ability.

Research on Chess Instruction

- Chess instruction may prove to be a valuable vehicle in enabling students to tap into more FI behaviors when these tasks are need for academic tasks.
- Some researchers have shown the value of chess instruction as it relates to improving math performance (Christiaen and Verholfstadt, 1981).
- Others have shown evidence of improved over-all I.Q. scores as a result of chess instruction (VanZyl, 1991).
- Research has conclusively shown that chess expertise in children is heavily dependent upon spatial ability (Horgan and Morgan, 1990; Harston and Wason, 1983).
- Chess expertise among adults is dependent upon logical thinking ability (DeGroot, 1978).
- High school students are a population that may represent a stage of development that forms the transition point for chess players relying on logical thinking rather than spatial ability.
- This critical stage of transition may be a vital area for cognitive study. Chess instruction may be a vehicle for improving students arsenal of cognitive abilities.

Females (n = 7)

Pre	Post	d_i	$(d_i - d)^2$	
9	13	4	$(4 - 3)^2$ =	1
1	4	3	$(3 - 3)^2$ =	0
5	11	6	$(6 - 3)^2$ =	9
10	13	3	$(3 - 3)^2$ =	0
6	3	-3	$(-3 - 3)^2$ =	36
2	4	2	$(2 - 3)^2$ =	1
11	17	6	$(6 - 3)^2$ =	9
n = 7		21	$\Sigma(d_i - d)^2$ =	56

$$d = d_i/n = 21/7 = 3$$

$$S_d = [\Sigma(d_i - d)^2/(n - 1)]^{1/2} = [56/6]^{1/2} = [9.33]^{1/2} = 3.055$$

$$t = (d)(S_d)^{-1}(n)^{1/2} = (3)(3.055)^{-1}(7)^{1/2} = 2.598 = 2.6$$

Calculated t-value = 2.6 Table Value (0.05 Level) = 2.447

Males (n = 4)

Pre	Post	d_i	$(d_i - d)^2$
18	18	0	$(0 + 1)^2 = 1$
8	9	1	$(1 + 1)^2 = 0$
4	7	3	$(3 + 1)^2 = 4$
1	1	0	$(0 + 1)^2 = 1$
		4	$\Sigma(d_i - d)^2 = 6$

$$d = d_i/n = 4/4 = 1$$

$$S_d = [\Sigma(d_i - d)^2/(n - 1)]^{1/2} = [6/3]^{1/2} = 2^{1/2} = 1.414$$

$$t = (d)(S_d)^{-1}(n)^{1/2} = (1)(1.414)^{-1}(4)^{1/2} = 2/1.414 = 1.414$$

Calculated t-value = 1.414 Table Value (0.05) = 3.182

Difference in GEFT Scores	W	L	D
10+	3	0	0
9	3	0	0
8	10	0	0
7	4	0	1
6	3	0	0
5	5	1	0
4	3	2	0
3	5	1	0
2	4	1	0
1	5	5	0
0	2	2	0

GEFT Test Difference	Winning Probability of player with higher score
8+	99
5-7	89
2-4	75
0-1	50

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